PATENT SPECIFICATION (11) 1278921

DRAWINGS ATTACHED

(21) Application No. 66/70 (22) Filed 1 Jan. 1970

(23) Complete Specification filed 4 Dec. 1970

(45) Complete Specification published 21 June 1972

(51) International Classification B60N 1/02

(52) Index at acceptance A4U 6

(72) Inventor FREDERICK GEORGE LOWE

(54) IMPROVEMENTS IN AND RELATING TO VEHICLE SEATS

(71) We, UNIVERSAL OIL PRODUCTS COMPANY, a Corporation organized and existing under the laws of the State of Delaware, United States of America, of 30 Algonquin Road, Des Plaines, Illinois 60016, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to vehicle seats.

According to the present invention there is provided a vehicle seat comprising a seat part guided by a mechanical linkage for upward and downward movement relative to a base part, a hydropneumatic spring connected between the seat and base parts and carrying the load of the seat part, the hydropneumatic spring comprising a piston and cylinder device in which a drive piston is movable within a liquid-containing chamber of the cylinder, the piston being carried on a piston rod which extends through an end wall of the chamber, and in which a restricted flow passage extends from one side of the piston to the other to permit a flow of liquid therethrough to damp the movement of the piston within the cylinder, the opposite end wall of the chamber being formed by a floating piston which fits slidingly within said cylinder opposite said drive piston, said floating piston forming an end wall of a gas-filled chamber of the hydropneumatic spring.

The present invention also provides a vehicle seat comprising a seat part supported on a suspension for upward and downward movement relative to a base part, said suspension including a hydropneumatic spring for opposing the downward movement of the seat part, the spring comprising a piston and cylinder device in which a floating piston fitted within the cylinder separates a gas-filled chamber from a liquid-containing chamber, and in which a drive piston, located in the liquid-containing chamber, is connected to a piston rod extending through an end wall of the chamber, a restricted flow path for liquid being formed through the drive piston, such that forward movement of the drive piston produces a corresponding but reduced movement of the floating piston, due to the movement of the liquid through the piston, and the latter movement damps the movement of the drive piston relative to the cylinder.

Some embodiments of a vehicle seat in accordance with the invention are illustrated in the accompanying drawings, in which:—

Figure 1 is a side elevation of a vehicle seat in which the seat part is in its up-stop position, the ride position and down-stop positions being shown in dotted line;

Figure 2 is a section through the hydropneumatic spring of Figure 1;

Figures 3, 4, 5 and 6 are side elevations, part sectioned, of four different embodiments of hydropneumatic spring, and

Figures 7a, b and c are sectional views of a second embodiment of seat suspension utilising hydropneumatic springs.

The vehicle seat shown in Figure 1 comprises a seat part 10 which is mounted for upward and downward movement relative to a base part 11 by means of a scissor-arm linkage 12 disposed in a vertical plane at each side of the seat, each linkage having two lever arms 13, 13′ one of which extends from a fixed pivot 14 at the back of the seat part downwardly to a movable pivot 15 at the forward end of the base part, the second lever arm 13′ extending from a fixed pivot 16 at the rearward end of the base part upwardly to a movable pivot 17 at the front part of the seat part, the two lever arms being pivoted at their intersection. Each movable pivot is formed by a roller 18 rolling in a horizontal guide 19.

The spring which carries the load of the seat is a hydropnuematic spring in the form of a piston and cylinder device 21 which is pivoted at its forward end to the seat part and is pivoted at its rearward end to the junction of the two arms 22a, 22b, of an L-shaped lever 22, the shorter arm 22a being pivoted at its outer end to the seat part at

[*Price 25p*]

23 and the longer arm 22b of the lever supporting a roller 24 at its outer end which rolls in a guideway 25 in the base part. This lever enables a substantially linear relationship to be obtained between the seat movement and the hydropneumatic spring stroke, and also provides a mechanical advantage. Although reference is made to a hydropneumatic spring, two or more such springs can be connected together in tandem in order to achieve the load range required.

The piston and cylinder device 21, as seen in Figure 2, comprises a cylinder 26, a drive piston 27 movable along the barrel of the cylinder by means of a piston rod 28 which extends through end wall 26b of the cylinder. The diameter of the piston rod is large in relation to the internal diameter of the cylinder so that a restricted annular space exists behind the piston. A piston 30, which is free or floating, is located between the drive piston and the closed end 26a of the cylinder and divides the interior of the cylinder into two chambers. Oil fills the space 31 between the two pistons and the space 32 behind the drive piston, and gas (for example nitrogen) fills the chamber 33 between the floating piston and the closed end 26a of the cylinder, the drive piston having one or more orifices 34 in it so that oil can leak from one side of the drive piston to the other during its motion along the cylinder barrel thus providing a hydraulic damping effect. Displacement of the piston rod 28, guided by the drive piston 27, towards the floating piston 30 causes the incompressible oil to force the floating piston against the gas thus reducing the gas volume and increasing its pressure. In this way the unit acts as a spring, the rate being determintd by the cross-sectional area of the piston rod, the gas volume and the gas pressure. The initial load is determined by the piston rod area and the filling pressure.

The closed end 26a of the cylinder of the spring is connected to the seat part 10 through a coupling which permits forward or rearward movement of the cylinder thereby varying the initial load of the seat part, i.e. the load in the UP-stop position. This coupling can comprise for example a screwed shaft 35 connected to a sliding trunnion block 36, the shaft mating with a nut 37 fixed in the seat part and being fitted with a knob 38 for manual rotation. The slidable adjustment of this pivot relative to the seat part has the effect of increasing or decreasing the initial volume and hence the pressure of the gas in the spring thus giving a variable initial load and spring rate according to the requirements of the seat occupant The up-stop position can be mechanically controlled by other means, for example stops at the end of the roller tracks.

The spring can include a multi-chamber cylinder, as shown in Figure 3. In this Figure, two additional reservoir chambers 40, 41 are formed within the wall of the cylinder barrel and these are connected to the main gas chamber 33, via a slide valve 42 which is movable to close the main gas chamber or connect it with one or both of the reservoir chambers in the wall of the cylinder barrel. The chambers are all at the same pressure, but the volume into which the gas can be compressed will be varied by movement of the spool of the slide valve. This will have the effect of giving three spring rates all starting at the same initial pressure. Of course the number of reservoir chambers provided in the wall of the cylinder is a matter of choice. The movement of the slide valve can be effected manually through an L-shaped lever 43 pivoted to the slide valve and movable into any one of a number of selectable positions in an associated rack 44 according to the desired position of the slide valve.

Figures 4 and 5 illustrate means for making a hydropneumatic spring self-adjusting in response to the load on the seat.

In Figure 5, a slide valve 142 is movable automatically by direct connection through a control member 46 to the floating piston so that the displacement of the floating piston towards the closed end 26a of the cylinder will progressively move the slide valve to reduce the number of reservoir chambers connected to the main gas chamber and thereby reduce the volume into which the gas can be compressed.

In Figure 4 a high-rate compression spring 47 is located between the closed end 26a of the gas cylinder and a cap 48 which has bearings 48a engageable in the trunnion 36. The cap fits over the closed end of the cylinder and is keyed to move axially against the force of the compression spring, the stem 242 of a slide valve extending through the closed end of the cylinder and constituting a control member to be engaged by the cap. In both Figures 4 and 5, no manual means of adjusting for the weight of the driver is required, the response of the suspension being entirely automatic in dependence on movement of the cylinder by the seat part.

Figure 6 shows an embodiment applicable either to a single or multi-chamber spring which includes provision for adjusting the height of the seat. In this case the oil filled chamber is made long enough to accommodate a piston stroke for both dynamic operation and seat-height adjustment, and the latter is effected by altering the datum position of a drive piston 127 about which it oscillates during vibration of the suspension. This is effected by bleeding oil from the main oil space 131, through a manually operated coaxial valve 50 in the drive piston 127, into a reservoir 51 formed within a

hollow piston rod 128. The reservoir contains a piston 52 which is biased by a spring 53 in a sense to reduce the volume of the reservoir, and with the seat under load, oil is forced into the spring-loaded reservoir 51 as long as the manually operable valve is held open, and the piston rod 128 correspondingly moves inwardly of the cylinder to take up the volume of the oil bled off. Conversely, by correct relationship of the balancing spring 53 and the reservoir piston area, reduction or removal of the driver load acting on the seat reduces the pressure of oil in the main space 131 and allows the oil in the reservoir, with the manually-operable valve 50 held open, to flow back into the main space 131 thereby raising again the datum level of the suspension until the valve is closed.

In this embodiment, the up-stop position is mechanically controlled as before at the highest level, but the datum or ride position of the seat is adjustable independently of the elastic spring rate of the suspension, i.e. independently of the weight of the seat occupant.

Figures 7a, b and c shows a second embodiment of seat suspension utilising hydropneumatic springs. The suspension comprises a seat part 60 supported above a base part 61 by two pairs of scissor-type linkages 62 disposed in vertical planes at opposite sides of the seat. Each linkage comprises one lever arm 63 extending from a fixed pivot 64 on the seat part forwardly and downwardly to a horizontally-sliding pivot 65 on the base part and a second lever arm 63′ extending from a fixed pivot 66 on the base part forwardly and upwardly to a horizontally-sliding pivot 67 on the seat part, the two lever arms being pivotally connected at their intersection.

Two piston and cylinder devices 68, 68′ such as those described above, extend side-by-side along the base part and are connected at their forward ends to a common manually-operable screw-adjustment mechanism 69 for varying the preload in the springs. The rearward ends of the devices 68, 68′ are connected to a lever mechanism 70 operable by the scissor-type linkages in such a way that downward movement of the linkages resulting from downward movement of the seat part imparts a forwardly-directed force to the rearward ends of the springs.

In particular, two couplings arms 71 are suspended pivotally from a horizontal transverse shaft 72 fixedly supported above the base part, the lower ends of the coupling arms being interconnected by a yoke 73 and pivotally connected to the rearward ends of the piston and cylinder devices. Upwardly extending plates 74 welded to the lower rearward ends of the linkage arms support rollers 75 at their upper ends which bear against the coupling arms and impart forward pivotal movement thereto in response to downward movement of the seat part.

Although reference is made to a leakage passage through the drive piston, the passage could be of substantial width but controlled by a valve to provide different leakage flow rates under different operating conditions.

WHAT WE CLAIM IS:—

1. A vehicle seat comprising a seat part guide by a mechanical linkage for upward and downward movement relative to a base part, a hydropneumatic spring connected between the seat and base parts and carrying the load of the seat part, the hydropneumatic spring comprising a piston and cylinder device in which a drive piston is movable within a liquid-containing chamber of the cylinder, the piston being carried on a piston rod which extends through an end wall of the chamber, and in which a restricted flow passage etxends from one side of the piston to the other to permit a flow of liquid therethrough to damp the movement of the piston within the cylinder, the opposite end wall of the chamber being formed by a floating piston which fits slidingly within said cylinder opposite said drive piston, said floating piston forming an end wall of a gas-filled chamber of the hydropneumatic spring.

2. A vehicle seat according to claim 1 in which the gas-filled chamber is defined between the floating piston and the end of the cylinder remote from the drive piston.

3. A vehicle seat comprising a seat part supported on a suspension for upward and downward movement relative to a base part, said suspension including a hydropneumatic spring for opposing the downward movement of the seat part, the spring comprising a piston and cylinder device in which a floating piston fitted within the cylinder separates a gas-filled chamber from a liquid-containing chamber, and in which a drive piston, located in the liquid-containing chamber, is connected to a piston rod extending through an end wall of the chamber, a restricted flow path for liquid being formed through the drive piston, such that forward movement of the drive piston produces a corresponding but reduced movement of the floating piston, due to the movement of the liquid through the piston, and the latter movement damps the movement of the drive piston relative to the cylinder.

4. A vehicle seat according to claim 2 or claim 3 having a gas filled reservoir communicating with the gas-filled chamber of the cylinder via a control valve operable to open or close thereby to vary the spring rate of the spring.

5. A vehicle seat according to claim 4 having a second gas-filled reservoir communicating with the gas-filled chamber via

a second control valve operable further to vary the spring rate.

6. A vehicle seat according to claim 4 or claim 5 having a control member movable in dependence upon the movement of the seat part relative to the base part to operate said control valve.

7. A vehicle seat according to claim 6 wherein the control member is located within the cylinder for movement by the floating piston.

8. A vehicle seat according to claim 6 wherein the control member extends outwardly through a wall of the cylinder for movement in response to the movement of the cylinder relative to one of said seat and base part.

9. A vehicle seat according to any one of claims 2 to 8 wherein said piston rod is hollow and contains a reservoir communicating via a leakage-control valve with the liquid-containing space on the side of the drive piston remote from the piston rod, the leakage-control valve being operable from outside the cylinder to permit liquid to flow into or out of the piston-rod reservoir thereby to vary the static-load position of the drive piston within the cylinder and hence the position of the seat part relative to the base part.

10. A vehicle seat substantially as herein described with reference to any one of the embodiments shown in the accompanying drawings.

MATHISEN & MACARA,
Chartered Patent Agents,
Lyon House, Lyon Road,
Harrow, Middlesex,
Agents for the Applicants.

Published by The Patent Office, 25 Southam by the Courier Press, Leamington Spa, 1972.
Printed for Her Majesty's Stationery Office, pton Buildings, London, WC2A 1AY, from which copies may be obtained

1278921 COMPLETE SPECIFICATION

4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

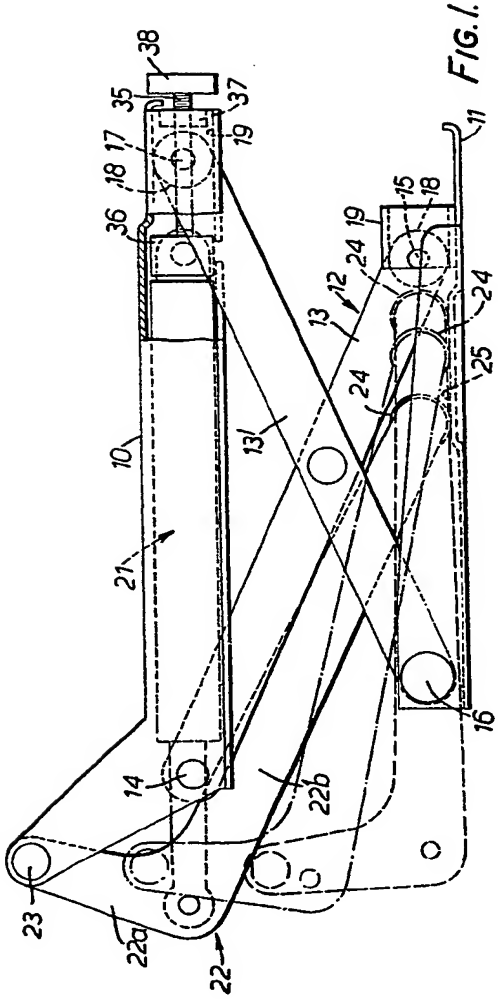

FIG. 1.

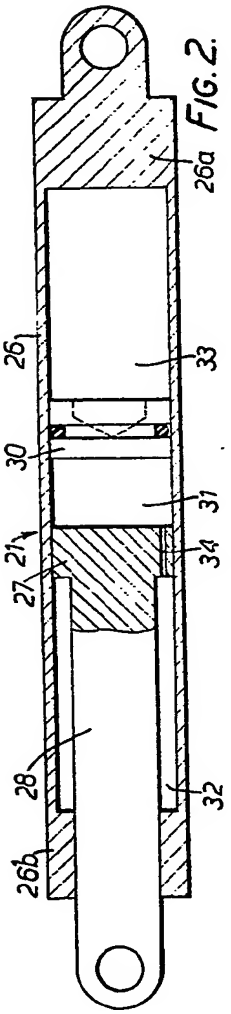

FIG. 2.

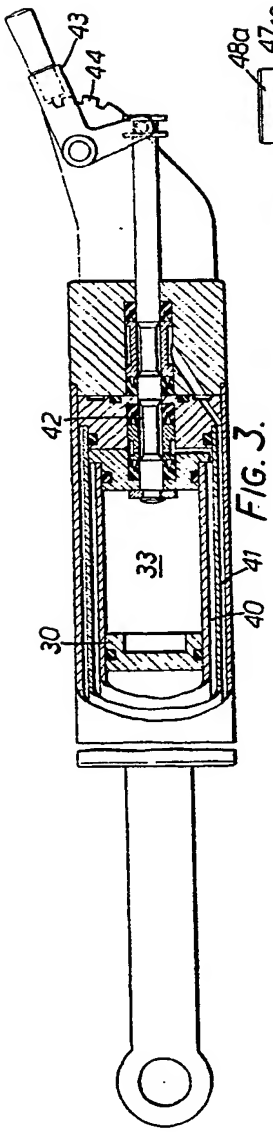

FIG. 3.

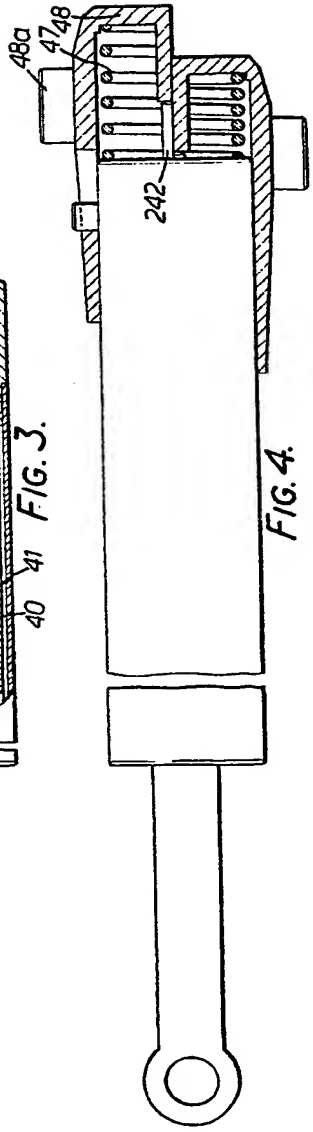

FIG. 4.

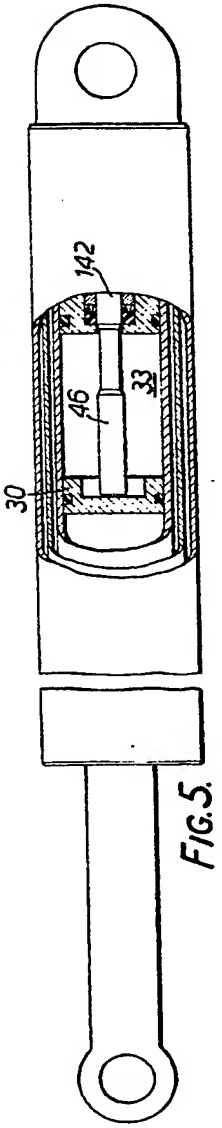

FIG. 5.

1278921 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 3

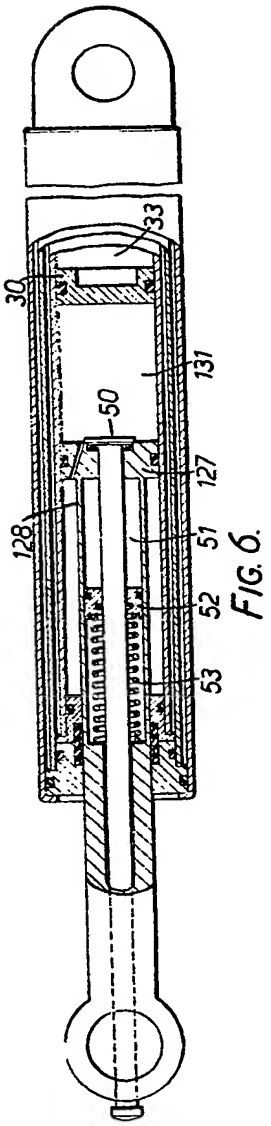

FIG. 6.

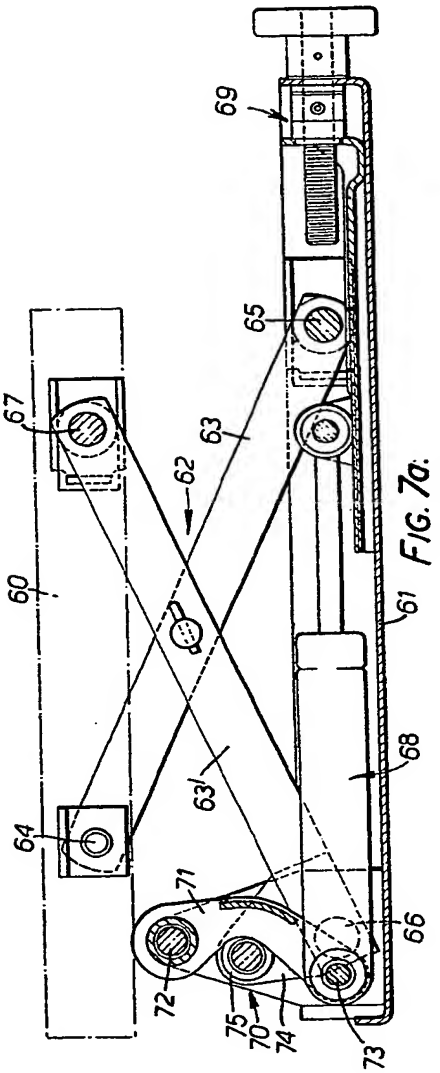

FIG. 7a.

1278921 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 4

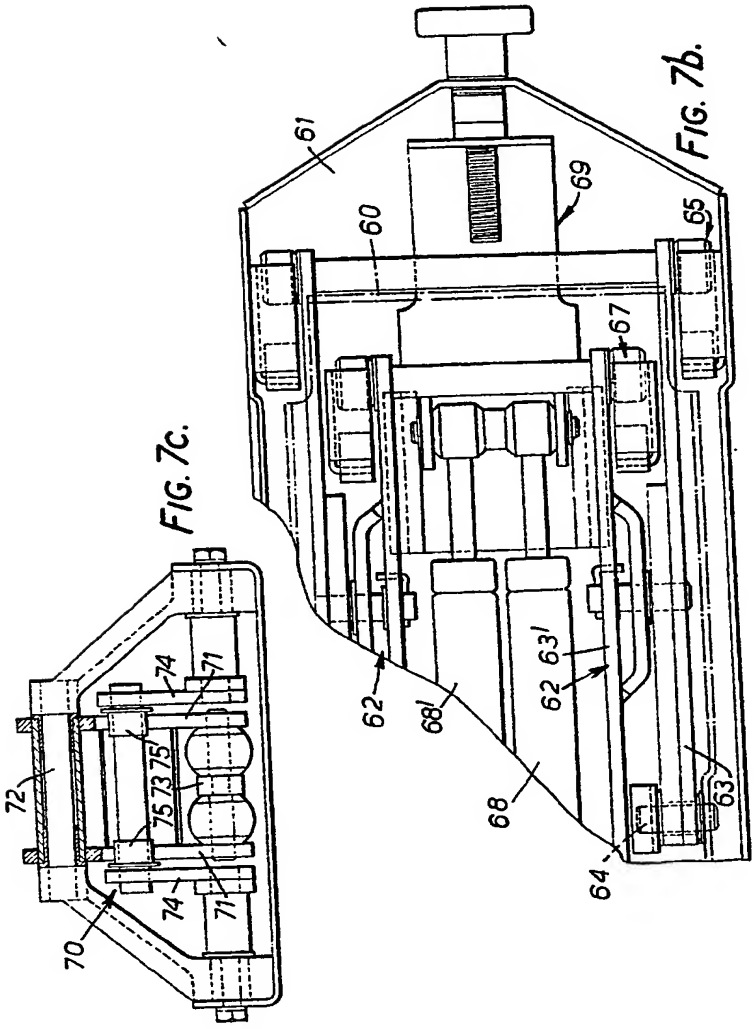

FIG. 7b.

FIG. 7c.